APPLYING MACHINE LEARNING IN THE FINANCIAL SECTOR

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ABSTRACT

In this research paper a survey is made of existing applications of machine learning in the financial sector. Also new and prospective applications of this technology are described in brief. The paper includes a discussion of how Big Data technologies can be applied in the finance sector and traces some leading application paths.

KEYWORDS: Machine learning; Financial applications ; Big Data applications in Finance.

I. Introduction

Machine Learning is basically giving computers an ability to learn without being programmed. Some key applications include the following:

- **Web Page Ranking:** Submitting a query to a search engine returns the most relevant answers that are sorted in the order of their relevance.

- Facial Recognition based on an input image used in security related applications.

- Classifying customers based on some criterion e.g. customers who are in need of financial products like insurance. This is done from a base universe consisting of all types of customers.

- Speech Recognition and handwriting recognition.

- Credit scoring systems used in financial applications.

The techniques of Machine Learning include Regression analysis, clustering, Decision trees, Neural Networks , Support Vector Machines (SVM) etc.

In supervised learning, the output datasets are provided which are used to train the machine and get the desired outputs whereas in unsupervised learning no datasets are provided, instead the data is clustered into different classes .

Example : Face recognition

Supervised learning: Learn by examples as to what a face is in terms of structure, color, etc so that after several iterations it learns to define a face

Unsupervised learning: since there is no desired output in this case that is provided therefore categorization is done so that the algorithm differentiates correctly between the face of a horse, cat or human clustering of data.
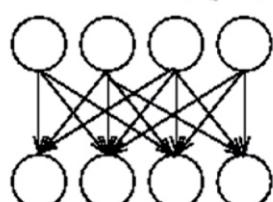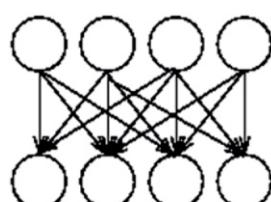
There have been several productive applications of Machine learning in the financial sector. This is enabled by its features like high volume, accuracy of recorded data and the quantitative nature of the financial sector. Some current applications include Loan approvals, asset management, risk profiling, market predictions etc.

The layout of this paper is as follows:
Section I deals with Introduction, Section II deals with literature review, section III deals with current applications & prospective applications and section IV deals with integrating Big Data Analytics for financial applications. The paper concludes with the scope for further work in this area of research and the listed references in the Bibliography.

II. Literature Review

In [1] the authors have discussed about Automatic reply of incoming messages, automatic organization of mail into folders. The summarization of e mails by extracting key sentences is also discussed here.

Speech recognition is described including customization in [2].

Recognizing handwriting for postal mail forwarding using machine learning is described in [3].

Information retrieval consisting of indexing, querying, comparision & feed back can be done efficiently using automated learning [4].

Anomaly detection e.g detection of unusual sequences of card transactions by looking at a sequence of operations using machine learning techniques is discussed in [5].

Stock market analysis is done using support vector machines(svm) & reinforcement learning in order to maximize profit of stock purchased, minimizing risk & use of sentiment analysis for this purpose is discussed in [6].

Sentiment analysis in product reviews can be used in business intelligence gathering and recommender systems[7].

The use of cluster analysis in organizing large computer systems for efficient data center management is discussed in [8].

Social network analysis including grouping of people & community identification is explained in [9].

The use of unsupervised learning can be done for doing market segmentation – for the purposes of customer differentiation [10].

Electronic medical records of patients can be analysed for understanding disease profiling in a community [11].

Understanding of genetic structures through unsupervised learning can be done for identifying common genetic sequences[12].

The organization of Documents through indexing using a controlled vocabulary can be done using machine learning[13].

The differentiation between genuine and spam mails can be done using a spam filter which uses machine learning [14].

Disease profiling in community health profiling is discussed in [15].

The use of machine learning techniques for studying financial markets is

described in [16],17],[18], [19]. The use of pattern analysis for future prediction of stock options based on past patterns is done dynamically.

E commerce sites are using recommender systems to give users customized choices and summaries of goods he or she is searching for. Both content based and collaborative recommendation systems are being offered giving novel & intelligent options to a user[20].

III. Current and Prospective Applications

1. **Portfolio Management:** This is an investment advisor program helping a client attain their financial goals by targeted investment. This is sensitive to real time changes in financial markets.

2. **Trading:** This enables rapid decision making. They are High frequency trading systems that make thousands of trades in a day . Hedge funds are an example of this.

3. **Fraud Detection:** Machine learning helps to learn anomalous behaviour thus detecting detections used in fraud detection in real time. Thus they are dynamic in nature.

4. **Loan and Insurance systems:** Machine learning systems can be trained on millions of examples of consumer data & lending results, thereby learning trends in this domain. The aim is to get accurate credit profiling aiming to minimize risk in lending.

Now we can describe some prospective applications.

1. **Customer relationship management:** Specialised text and voice based chat interfaces to help answer customer queries on personal finances & investment options.

2. **User security:** New security modules based on facial recognition, voice recognition and biometrics data can be developed.

3. **Sentiment Analysis:** New trends in social media, news trends and data from other sources can be used . AI based Hedge funds are an example of this. Also sentiment can be discovered from prevailing trends & news regarding the stock options of a company.

4. **Recommendations of Financial products:** Recommendations of insurance policies, investment options, and personally customized applications for a client can be developed. This is similar to recommendations of books by Amazon and films by various sites including IMDB etc.

IV. Integration with Big Data and Business Analytics.

Much of the current debate around big data is locked in technological advancements. This misses the point that the real strategic value in the data is the insight it can give into what will happen in the future. Predicting how customers and competitors' customers will behave and how that behaviour will change is critical to tailoring and pricing products. Big data should be about changing the way you do business to harnesses the real value in your data, re-shape the interaction with the market and increase the lifetime value of your customers. Therefore, which data is required to achieve these objectives, who needs it and how often are key pieces of the big data puzzle.

Big data should also involve using multiple data sources, internally and externally. Geo-spatial data, social media, voice, video and other unstructured data all have their part to play in knowing the customer today and their future behaviours. For example, leading firms are looking at using both internal and external data, both structured and unstructured, to develop personalised banking products. Customers are more likely to be attracted and retained with personalised products - hence, lifetime value goes up. Similarly, analytics have an increasingly important part to play in the recovery of bad debt. Recoveries functions typically target based on the delinquency status of the account. However, a better understanding of customer circumstances can improve targeting and have an immediate impact on recovery rates while also reducing cost.

Hence Big Data is being leveraged to:

• Reducing cost & improving operational efficiencies.

• Scientific and rigorous analysis of data.

• Integration with social media: Some examples are Sentiment analysis e.g. for financial products & company image, and Targeted marketing campaigns.

V. Conclusions and Scope for further work

The applications of Machine learning in the financial sector have been surveyed in this brief paper. Both current & prospective applications have been described. Integration of Big Data for prospective applications has been described.

In future use of big data and machine learning for obtaining customer specific business intelligence will get lot of importance. In addition innovative use of social media will complement the data analysis of customer data for design of

new financial products and customized applications for individual customers and specific needs will get importance also. Due to high visibility of this sector this will attract greater attention of technology & financial companies.

BIBLIOGRAPHY

[1] Tzanis, George, et al. "Modern Applications of Machine Learning. "Proceedings of the 1st Annual SEERC Doctoral Student Conference-DSC 2006.

[2] Mitchell, Tom Michael. The discipline of machine learning. Carnegie Mellon University, School of Computer Science, Machine Learning Department, 2006.

[3] Ball, Gregory R., and Sargur N. Srihari. "Semisupervised learning for handwriting recognition." Document Analysis and Recognition, 2009. ICDAR'09. 10th International Conference on. IEEE, 2009.

[4] Cunningham, Sally Jo, James Littin, and Ian H. Witten. "Applications of machine learning in information retrieval." (1997).

[5] Wiese, Bénard, and Christian Omlin. Credit card transactions, fraud detection, and machine learning: Modelling time with LSTM recurrent neural networks. Springer Berlin Heidelberg, 2009.

[6] Shen, Shunrong, Haomiao Jiang, and Tongda Zhang. "Stock market forecasting using machine learning algorithms." (2012).

[7] Pang, Bo, Lillian Lee, and Shivakumar Vaithyanathan. "Thumbs up?: sentiment classification using machine learning techniques." Proceedings of the ACL-02 conference on Empirical methods in natural language processing-Volume 10. Association for Computational Linguistics, 2002.

[8] Liao, Shih-wei, et al. "Machine learning-based prefetch optimization for data center applications." Proceedings of the Conference on High Performance Computing Networking, Storage and Analysis. ACM, 2009.

[9] Haider, Peter, Luca Chiarandini, and Ulf Brefeld. "Discriminative clustering for market segmentation." Proceedings of the 18th ACM SIGKDD international conference on Knowledge discovery and data mining. ACM, 2012.

[10] Haider, Peter, Luca Chiarandini, and Ulf Brefeld. "Discriminative clustering for market segmentation." Proceedings of the 18th ACM SIGKDD international conference on Knowledge discovery and data mining. ACM, 2012.

[11] Kononenko Igor,"Machine learning for medical diagnosis:history,state of the art and perspective", Artificial Intelligence in medicine23.1(2001):89-109.

[12] Cho, Sung-Bae, and Hong-Hee Won. "Machine learning in DNA microarray analysis for cancer classification." Proceedings of the First Asia-Pacific bioinformatics conference on Bioinformatics 2003-Volume 19. Australian Computer Society, Inc., 2003.

[13] Sebastiani, Fabrizio. "Machine learning in automated text categorization." ACM computing surveys (CSUR) 34.1 (2002): 1-47.

[14] Bratko, Andrej, et al. "Spam filtering using statistical data compression models." The Journal of Machine Learning Research 7 (2006): 2673-2698.

[15] Magoulas, George D., and Andriana Prentza. "Machine learning in medical applications." Machine Learning and its applications. Springer Berlin Heidelberg, 2001. 300-307.

[16] Boyarshinov, Victor. Machine learning in computational finance. Diss. Rensselaer Polytechnic Institute, 2005.

[17] Pawar, Prashant. Machine Learning applications in financial markets. Diss. Indian Institute of Technology, Bombay Mumbai.

[18] Prof. St´ephan Cl´emen ,―A Machine-Learning View of Quantitative Finance‖, con - Institut Mines Telecom LTCI UMR Telecom Paris Tech.

[19] Shen, Shunrong, Haomiao Jiang, and Tongda Zhang. "Stock market forecasting using machine learning algorithms." (2012).

[20] https://www.coursera.org/learn/recommender-systems .